

CONTRIBUTIONS  
FROM THE  
CUSHMAN LABORATORY  
FOR  
FORAMINIFERAL RESEARCH

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# CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

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# CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

## THE FORAMINIFERA OF THE TYPE LOCALITY OF THE NAHEOLA FORMATION\*

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By JOSEPH A. CUSHMAN and RUTH TODD

While the type locality of a formation may not always have the richest or best preserved fauna, it is of interest to know that fauna in detail for comparison with other localities which may be referred to the same formation. Therefore it has seemed of some value to give as completely as possible the foraminiferal fauna of the Naheola formation from its type locality: Naheola Landing, on Tombigbee River, Choctaw Co., Alabama. The material used is from the upper fossiliferous horizon of the greensand bed, collected by T. Wayland Vaughan (U. S. G. S. Loc. 5647).

It is interesting to compare the fauna of this type Naheola with faunas of other parts of the Midway group and with faunas of the various formations of the Wilcox group.

The pioneer work of Mrs. Plummer on the Midway foraminifera of Texas included two rather distinct faunas referred to as the upper and lower parts of the Midway. The fauna recorded by Cushman from near Livingston, Sumter Co., Ala., is probably typical of the Sucarnoochee clay and should be slightly older than the Naheola formation described here. Another fauna of Midway age, that of the Soldado Rock, off Trinidad, B. W. I., described by Cushman and Renz, seems from the comparison of the fauna to belong to the upper part of the Midway. Allowance must be made for the considerable distance between these various localities, and the probable changes in ecologic conditions under which the faunas lived. It would be of interest in geologic mapping and in stratigraphic work if more were known about the ecologic factors, particularly depth of water at which the faunas lived, in order to give information which would indicate the position of the shoreline during the deposition of these various formations.

It is evident from a comparison of this Naheola fauna with that described and figured by Toulmin from the Salt Mountain limestone of Alabama that, as might be expected, the Naheola fauna is rather closely related to this lower part of the Wilcox Eocene. A number of the species also occur in the fauna described by Cushman and Ponton from the Eocene of Wilcox age from a R. R. cut, 1 mile N. of Ozark, Ala. Some of the species also are identical with or related to those of the fauna described by Jennings from the Hornerstown marl of New Jersey.

From a study of this Naheola fauna it would seem that the depth of water must have been considerable as the fauna is dominated by representatives of Lagenidae and Polymorphinidae, two foraminiferal families which occur at the present time most abundantly on the continental shelves in waters of 25 to 100 fathoms. The almost entire absence of the arenaceous group, such as Textulariidae, and the porcellaneous group of Miliolidae would also tend to corroborate this inference. Dr. Julia A. Gardner has confirmed the conclusion as to depth from the molluscan fauna in which the heavier shallow-water species are largely absent in the Naheola formation.

For reference, the titles of several papers dealing with the foraminifera of the Midway and related Wilcox faunas are here given:

Cushman, J. A., Midway Foraminifera from Alabama, Contr.

Cushman Lab. Foram. Res., vol. 16, 1940, pp. 51-73, pls. 9-12.

Cushman, J. A. and Garrett, J. B., Eocene Foraminifera of Wilcox Age from Woods Bluff, Alabama, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, pp. 77-89, pls. 13-15.

Cushman, J. A. and Ponton, G. M., An Eocene Foraminiferal Fauna of Wilcox Age from Alabama, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, pp. 51-72, pls. 7-9.

Cushman, J. A. and Renz, H. H., Eocene, Midway, Foraminifera from Soldado Rock, Trinidad, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, pp. 1-14, pls. 1-3.

Jennings, P. H., A Microfauna from the Monmouth and Basal Rancocas Groups of New Jersey, Bull. Amer. Pal., vol. 23, No. 78, 1936, pp. 3-72, pls. 1-5.

Plummer, Helen Jeanne, Foraminifera of the Midway Formation in Texas, Univ. Texas Bull. 2644, 1927, pp. 1-206, pls. 1-15.



Plummer, Helen Jeanne, Epistominoides and Coleites, New Genera of Foraminifera, Amer. Midland Nat., vol. 15, 1934, pp. 601-608, pl. 24.

Toulmin, Lyman D., Eocene Smaller Foraminifera from the Salt Mountain Limestone of Alabama, Journ. Pal., vol. 15, 1941, pp. 567-611, pls. 78-82.

### Family TEXTULARIIDAE

#### Genus SPIROPLECTAMMINA Cushman, 1927

SPIROPLECTAMMINA LAEVIS (Roemer), var. CRETOSA Cushman (Pl. 5, fig. 1)

*Spiroplectammina laevis* (ROEMER), var. *cretosa* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 87, pl. 11, fig. 3; l. c., vol. 16, 1940, p. 52, pl. 9, fig. 3.

This variety was described from the Cretaceous, Taylor marl, of Texas. It has a long range, occurring also in the Navarro and in the upper bed of the Midway near Livingston, Ala. It is rare in the Naheola material.

### Family MILIOLIDAE

#### Genus QUINQUELOCULINA d'Orbigny, 1826

QUINQUELOCULINA PLUMMERAE Cushman and Todd, n. sp. (Pl. 5, fig. 2)

*Quinqueloculina ferussacii* PLUMMER (not D'ORBIGNY), Univ. Texas Bull. 2644, 1927, p. 161, pl. 12, fig. 10.

Test small, nearly as broad as long, in end view about twice as broad as thick, periphery truncate with rounded, carinate edges; chambers distinct, the sides flattened or slightly concave toward the periphery; sutures distinct but little if at all depressed; wall smooth; aperture terminal, without a neck, but with a slightly thickened lip and a short blunt tooth. Length 0.20 to 0.25 mm.; breadth 0.15 mm.; thickness 0.08 mm.

Holotype (Cushman Coll. No. 38286) from Naheola formation of Midway age, greensand bed, upper fossiliferous horizon, Naheola Landing, Tombigbee River, Ala.

This species was referred to *Quinqueloculina ferussacii* d'Orbigny, but d'Orbigny's model shows that it is a very different species. Our species is much smaller, shorter, and without a definite neck.

Genus *TRILOCULINA* d'Orbigny, 1826*TRILOCULINA LAEVIGATA* Bornemann (Pl. 5, fig. 3)

*Triloculina laevigata* BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 350, pl. 19, fig. 5.—PLUMMER, Univ. Texas Bull. 2644, 1927, p. 161, pl. 12, fig. 11.

This species from the Naheola locality is similar to that referred by Mrs. Plummer to Bornemann's species. The originals were described from the Oligocene of Hermsdorf, near Berlin. Mrs. Plummer's specimens were from the upper part of the Midway. A number of specimens were found in our material.

The name *Triloculina laevigata* was used by d'Orbigny in 1826 for a different species, but it was not figured or adequately described, and therefore Bornemann's name is used.

## Family LAGENIDAE

Genus *ROBULUS* Montfort, 1808*ROBULUS MIDWAYENSIS* (Plummer) (Pl. 5, figs. 4, 5)

*Cristellaria midwayensis* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 95, pl. 13, fig. 5.

*Robulus midwayensis* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 55, pl. 9, fig. 12.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 579, pl. 78, fig. 23; text fig. 2G.

*Lenticulina midwayana* ISRAELSKY, Proc. 6th Pac. Sci. Congress, 1939, p. 573, pl. 2, figs. 7, 8.

This species was described from the Midway of Texas where it is recorded both in the upper and lower portions by Mrs. Plummer. It occurs in the upper bed in the Alabama material from near Livingston. Toulmin records it as common in the Nanafalia formation of the lower Wilcox Eocene of Alabama, in the uppermost portion of the Salt Mountain limestone, and most abundant in the Wilcox marl just above the Salt Mountain limestone. It occurs in our Naheola material in typical form. Cole and Gillespie (Bull. Amer. Pal., vol. 15, No. 57b, 1930, p. 6, pl. 2, fig. 12) record it from the Oligocene of Mexico, but from the figure it does not seem typical. Israelsky records it from the Eocene of Marysville Buttes, Calif.

The variety *carinatus* (Plummer) was not found in the Naheola material.



**ROBULUS WILCOXENSIS** Cushman and Ponton (Pl. 5, fig. 7)

*Robulus wilcoxensis* CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 52, pl. 7, fig. 3.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 579, pl. 78, figs. 24, 25; text fig. 2H.

This species was described from the Wilcox Eocene from R. R. cut, 1 mile N. of Ozark, Ala. It occurs in the Naheola material, from which one specimen is figured. The Naheola specimens differ slightly from the typical; the umbonate region of our specimens being slightly more thickened and the sutures of the early portion less raised and not distinctly limbate. More specimens may show this species to be distinguishable from *Robulus wilcoxensis*. Toulmin records and figures specimens from the Salt Mountain area of Alabama, and mentions that it is common in the upper Midway limestone of Ft. Gaines, Ala.

**Genus LENTICULINA** Lamarck, 1804

**LENTICULINA** cf. **ROTULATA** Lamarck (Pl. 5, fig. 6)

A few specimens in the Naheola material seem to belong to *Lenticulina* rather than to *Robulus*, and are somewhat like *L. rotulata* Lamarck, but are not typical. Mrs. Plummer records a similar form from the upper part of the Midway of Texas under this name.

**Genus PLANULARIA** Defrance, 1824

**PLANULARIA** sp. (Pl. 5, fig. 8)

Rare specimens similar to that figured on our plate occur in the Naheola material. They are very similar to that figured by Toulmin (Journ. Pal., vol. 15, 1941, p. 580, pl. 78, figs. 27, 28) as "*Astacolus jugleri* (Reuss)" from the Salt Mountain limestone of Alabama. An examination of available European specimens, however, seems to make it questionable whether or not this is the same as Reuss' species. There are not enough specimens in the Naheola material to warrant positive identification.

**Genus MARGINULINA** d'Orbigny, 1826

**MARGINULINA** cf. **SCITULA** (Berthelin) (Pl. 5, fig. 9)

A few specimens of this variable form occur in the Naheola material. It is recorded by Mrs. Plummer as very rare in the upper part of the Midway of Texas. (Univ. Texas Bull. 2644, 1927, p. 100, pl. 7, fig. 5). It occurred also in the upper bed of the Midway near Livingston, Ala. (Contr. Cushman Lab. Foram.

Res., vol. 16, 1940, p. 56, pl. 9, figs. 21, 22), and in the Midway material of Soldado Rock, off Trinidad, B. W. I. (l. c., vol. 18, 1942, p. 5, pl. 1, fig. 7). It is doubtful if these are really identical with Reuss' species.

### Genus DENTALINA d'Orbigny, 1826

#### DENTALINA PSEUDO-OBLIQUESTRIATA (Plummer) (Pl. 5, fig. 10)

*Nodosaria pseudo-obliquistriata* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 87, pl. 4, fig. 18.

*Dentalina pseudo-obliquistriata* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 58, pl. 10, fig. 18.

This species was described by Mrs. Plummer from the Midway of Texas where it is recorded as very frequent in the lower portion. It was found in the upper bed of the Midway near Livingston, Ala., but not in the lower bed. It occurs in typical form in the Naheola material.

*Dentalina pseudo-obliquistriata* is one of those species which seem to indicate that ecologic conditions or migration may account for occurrences in the upper part of the Midway of Alabama of species confined to the lower part of the Midway in Texas.

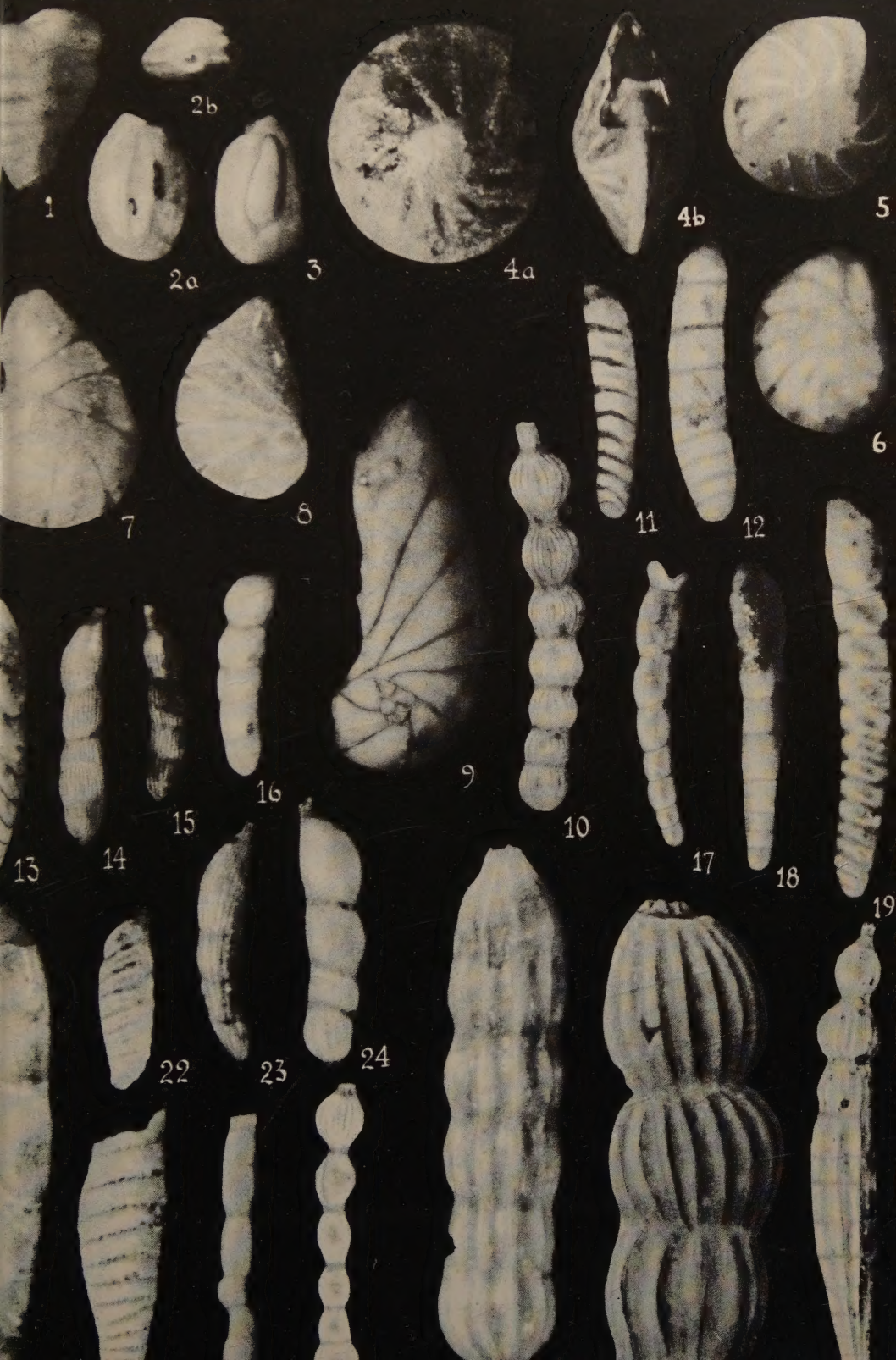
#### DENTALINA cf. MUCRONATA Neugeboren (Pl. 5, fig. 13)

The figured specimen shows the general character of this form which is referred questionably to Neugeboren's species. The

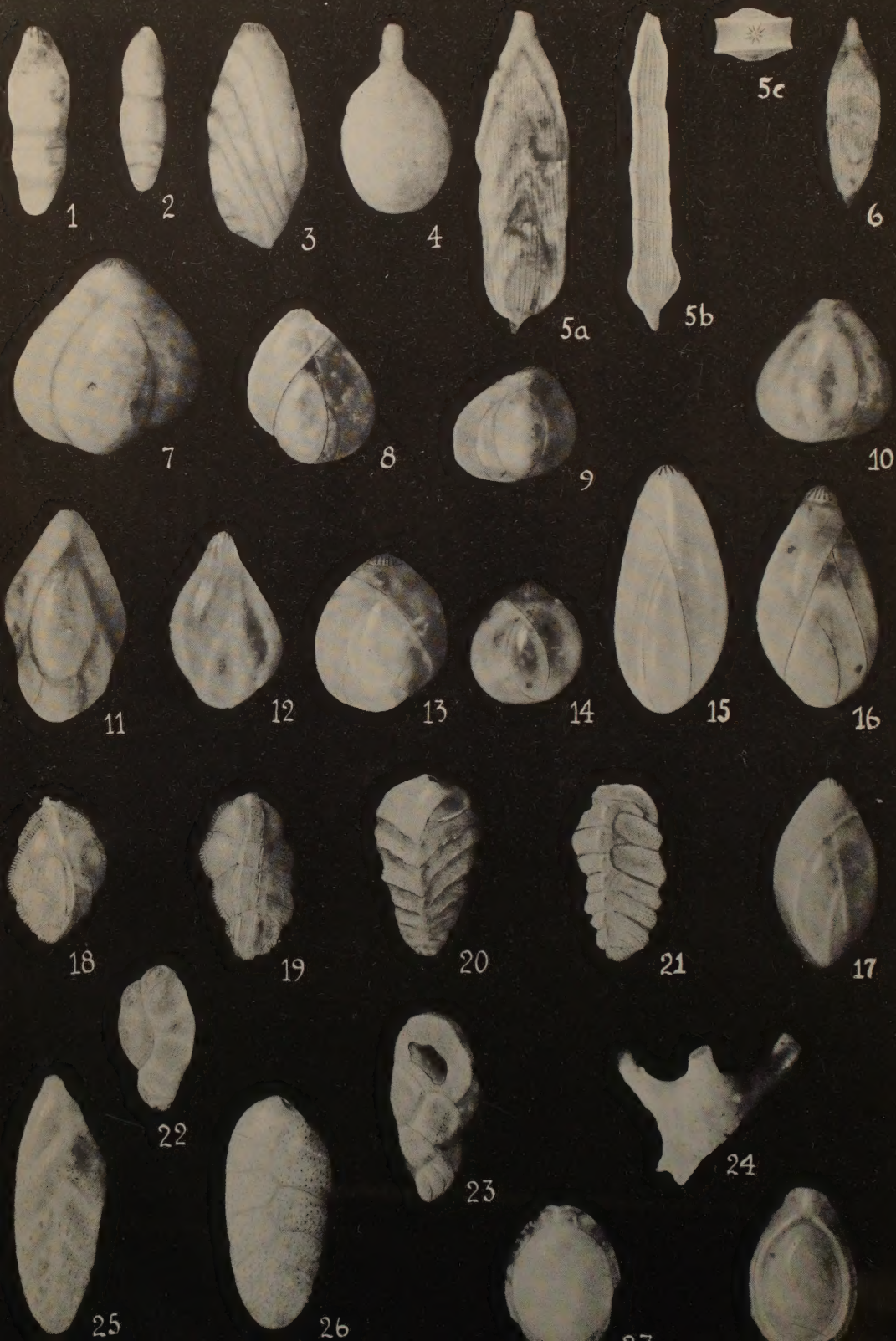
### EXPLANATION OF PLATE 5

- FIG. 1. *Spiroplectammina laevis* (Roemer), var. *cretosa* Cushman.  $\times 95$ .  
 2. *Quinqueloculina plummerae* Cushman and Todd, n. sp.  $\times 90$ . a, side view; b, apertural view. 3. *Triloculina laevigata* Bornemann.  $\times 95$ .  
 4, 5. *Robulus midwayensis* (Plummer). 4,  $\times 25$ . a, side view; b, peripheral view. 5,  $\times 30$ . 6. *Lenticulina cf. rotulata* Lamarck.  $\times 40$ . 7. *Robulus wilcoxensis* Cushman and Ponton.  $\times 60$ . 8. *Planularia* sp.  $\times 60$ . 9. *Marginulina cf. scitula* (Berthelin).  $\times 75$ . 10. *Dentalina pseudo-obliquistriata* (Plummer).  $\times 60$ . 11, 12. *D. gardnerae* (Plummer).  $\times 60$ . 13. *D. cf. mucronata* Neugeboren.  $\times 60$ . 14, 15. *D. delicatula* Cushman, var. *naheolensis* Cushman and Todd, n. var.  $\times 60$ . 14, Holotype. 15, Paratype. 16. *D. sp.*  $\times 60$ . 17, 18. *D. cf. pauperata* d'Orbigny.  $\times 60$ . 19. *D. sp.*  $\times 60$ . 20. *D. sp.*  $\times 60$ . 21, 22. *Vaginulina robusta* Plummer.  $\times 30$ . 23. *Dentalina* sp.  $\times 60$ . 24. *D. sp.*  $\times 90$ . 25. *Nodosaria* (?) *longiscata* d'Orbigny.  $\times 75$ . 26. *N. sp.*  $\times 60$ . 27-29. *N. affinis* Reuss. 27,  $\times 30$ . 29,  $\times 25$ .











initial end is pointed or actually ends in a short spine. The sutures are very oblique, especially in the early portion, and only the later chambers are distinctly inflated. Similar specimens occurred in the Midway material from near Livingston, Ala. (Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 57, pl. 10, fig. 27).

**DENTALINA GARDNERAE (Plummer) (Pl. 5, figs. 11, 12)**

*Marginulina gardnerae* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 106, pl. 5, fig. 11.

*Dentalina* (?) *gardnerae* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 57, pl. 10, figs. 10-12.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 585, pl. 79, fig. 15.

This species was described from the lower part of the Midway of Texas. It occurs in the upper bed of the Midway material near Livingston, Ala., and in the Naheola material. Toulmin records it as common in the upper portion of the Salt Mountain limestone of Alabama, and frequent in the Wilcox marl above the Salt Mountain limestone.

**DENTALINA cf. PAUPERATA d'Orbigny (Pl. 5, figs. 17, 18)**

Rare specimens of the form figured occur in the Naheola material. Many forms have been assigned to this species. A similar form occurred in the upper bed near Livingston, Ala. (Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 58, pl. 10, fig. 15). Mrs. Plummer figured an identical form from the upper part of the Midway of Texas as "*Nodosaria pauperata*

**EXPLANATION OF PLATE 6**

FIGS. 1, 2. *Pseudoglandulina manifesta* (Reuss). 1,  $\times 60$ . 2,  $\times 90$ . 3. *Palmyra* cf. *budensis* (Hantken).  $\times 85$ . 4. *Lagena* cf. *laevis* (Montagu).  $\times 75$ . 5, 6. *Frondicularia naheolensis* Cushman and Todd, n. sp.  $\times 60$ . 5, Holotype. a, side view; b, edge view; c, apertural view. 6, Paratype, young. 7-10. *Guttulina* cf. *problema* d'Orbigny. 7, 8,  $\times 80$ . 9,  $\times 40$ . 10,  $\times 75$ . 9, 10. Young. 11, 12. *G. hantkeni* Cushman and Ozawa. 11,  $\times 40$ . 12,  $\times 75$ . 13, 14. *Globulina gibba* d'Orbigny. 13,  $\times 40$ . 14,  $\times 75$ . 15. *Sigmomorphina wilcoxensis* Cushman and Ponton.  $\times 95$ . 16, 17. *S.* cf. *semitecta* (Reuss), var. *terquemiana* (Fornasini).  $\times 90$ . 18, 19. *Pseudouvigerina nahcolensis* Cushman and Todd, n. sp.  $\times 90$ . 18, Holotype. 19, Paratype. 20, 21. *Eouvigerina excavata* Cushman.  $\times 140$ . 22, 23. *Robertina wilcoxensis* Cushman and Ponton.  $\times 90$ . 24. *Ramulina* cf. *aculeata* (d'Orbigny).  $\times 95$ . 25. *Bolivina* sp.  $\times 125$ . 26. *B.* sp.  $\times 130$ . 27. *Entosolenia* cf. *laevigata* (Reuss).  $\times 95$ . 28. *E. crumenata* Cushman.  $\times 105$ .

d'Orbigny" (Univ. Texas Bull. 2644, 1927, p. 79, pl. 4, fig. 11). Our specimens are also very similar to that figured by Toulmin as "*Dentalina colei* Cushman and Dusenbury" (Journ. Pal., vol. 15, 1941, p. 584, pl. 79, fig. 12), but are not the same as *D. colei*.

**DENTALINA DELICATULA** Cushman, var. **NAHEOLENSIS** Cushman and Todd, n. var.  
(Pl. 5, figs. 14, 15)

Variety differing from the typical in the smaller, more delicate test; fewer chambers; and finer ornamentation. Length of holotype 0.65 mm.; diameter 0.10 mm.; other incomplete specimens up to 0.75 mm. in length.

Holotype of variety (Cushman Coll. No. 38287) from Naheola formation of Midway age, greensand bed, upper fossiliferous horizon, Naheola Landing, Tombigbee River, Ala.

These are not the same as that referred to *D. delicatula* from the Midway near Livingston, Ala. (Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 56, pl. 10, figs. 22-24).

**DENTALINA** sp. (Pl. 5, fig. 19)

Not enough specimens were found in the Naheola material to warrant positive identification of this form figured on our plate. It is very elongate with distinctly thickened, but not raised, sutures. The figured specimen is evidently megalospheric, and microspheric ones would be necessary to definitely identify the species.

**DENTALINA** sp. (Pl. 5, figs. 16, 20, 23, 24)

A number of species of *Dentalina* are present in the Naheola material, but are represented by too few specimens to be definitely identified. Some of these are figured for reference.

**Genus NODOSARIA** Lamarck, 1812

**NODOSARIA AFFINIS** Reuss (Pl. 5, figs. 27-29)

This species described from the Cretaceous of Central Europe is abundant in the Upper Cretaceous of America, and apparently also in the Eocene. It is very variable in the number of the costae which usually increase in number toward the apertural end. The chambers vary also in the relative amount of inflation. The microspheric and megalospheric forms also show great differences in shape and size, particularly of the early portion.

D'Orbigny also described a *Nodosaria affinis* from the Miocene of the Vienna Basin, but a study of topotypes shows that his is



a quite different species although some of the Eocene material referred to it is probably identical with the species described by Reuss.

Mrs. Plummer figured specimens of *N. affinis* from the Midway of Texas, and recorded it as abundant in the lower part (Univ. Texas Bull. 2644, 1927, p. 89, pl. 14, fig. 2). It occurs in the Midway material from near Livingston, Ala. (Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 59, pl. 10, figs. 30-33), and from the Midway of Soldado Rock, off Trinidad (l. c., vol. 18, 1942, p. 6, pl. 1, figs. 8-10). Toulmin figures similar forms (Journ. Pal., vol. 15, 1941, pp. 587, 588, pl. 79, figs. 25-30) under several names.

A study of topotypes of *N. affinis* Reuss and *N. latejugata* Gümbel shows that the two are very closely related if not identical. Our specimens from the Naheola and other Midway localities seem identical with *N. affinis* Reuss.

**NODOSARIA (?) LONGISCATA d'Orbigny (Pl. 5, fig. 25)**

A single specimen identical with that found in the Alabama Midway (Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 59, pl. 10, fig. 28) occurred in the Naheola material. Mrs. Plummer records it from the Midway of Texas (Univ. Texas Bull. 2644, 1927, p. 82, pl. 4, fig. 17). Sherborn and Chapman record it from the London clay, also of lower Eocene age. It seems questionable if any of these are the same as d'Orbigny's Miocene species. It is also probable that this is not a *Nodosaria*, but more specimens are needed to give the full structure.

**NODOSARIA sp. (Pl. 5, fig. 26)**

The slender species figured is very rare in the Naheola material, and is difficult to determine without more specimens. It is here figured so that it may be recorded for future workers.

**Genus PSEUDOGLANDULINA Cushman, 1929**

**PSEUDOGLANDULINA MANIFESTA (Reuss) (Pl. 6, figs. 1, 2)**

*Glandulina manifesta* REUSS, Haidinger's Nat. Abhandl., vol. 4, pt. 1, 1851, p. 6, pl. 1, fig. 4.—FRANKE, Abhandl. Preuss. Geol. Landes., n. ser., vol. 111, 1928, p. 52, pl. 4, fig. 28.—CUSHMAN and CHURCH, Proc. Calif. Acad. Sci., ser. 4, vol. 18, 1929, p. 511, pl. 39, fig. 10.

*Nodosaria manifesta* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 594, pl. 18, fig. 8.—SANDIDGE, Journ. Pal., vol. 6, 1932, p. 278, pl. 42, fig. 8.

*Pseudoglandulina manifesta* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 60, pl. 11, fig. 1.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 590, pl. 79, fig. 32.

*Nodosaria larva* CARSEY, Univ. Texas Bull. 2612, 1926, p. 31, pl. 2, fig. 2.

*Nodosaria humilis* CUSHMAN (not ROEMER), Tenn. Div. Geol. Bull. 41, 1931, p. 32, pl. 4, fig. 5.

The types of this species are from the Upper Cretaceous of Lemberg. The type figure evidently represents the microspheric form of the species, which has a pointed initial end, often with a small spine, and the whole test rapidly tapering. Such forms are comparatively rare, but with them is usually the megalospheric form, which has a large proloculum with a rounded base and the test much more nearly cylindrical. In the early stages the chambers are much overlapping, and there is little or no inflation of the chambers, but in the adult they are much inflated, with deeper sutures. The wall is smooth and polished, and the aperture terminal and radiate.

The species is common and widely distributed in the American Upper Cretaceous. It occurs in the Naheola material, and is undoubtedly the same as the form figured by Mrs. Plummer as "*Nodosaria radricula* (Linnaeus)" from the upper part of the Midway of Texas (Univ. Texas Bull. 2644, 1927, p. 77, pl. 4, fig. 9). It also occurs in the upper bed of the Midway near Livingston, Ala. Toulmin records it as rare in the Wilcox, Salt Mountain limestone, of Alabama.

#### Genus VAGINULINA d'Orbigny, 1826

VAGINULINA ROBUSTA Plummer (Pl. 5, figs. 21, 22)

*Vaginulina robusta* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 112, pl. 6, fig. 4; pl. 13, fig. 3.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 61, pl. 10, figs. 1-4.—CUSHMAN and RENZ, l. c., vol. 18, 1942, p. 6, pl. 2, figs. 1, 2.

Originally described from the Midway of Texas, where it is recorded as common in the upper part, this species seems to be an excellent index fossil for the Midway. It occurs in typical form in the lower bed of Midway age near Livingston, Ala., and in the Midway of Soldado Rock, off Trinidad. It occurs rather commonly in our Naheola material.



The species is extremely variable in the degree of ornamentation of the surface. Some specimens are nearly smooth, and there are all degrees between this and specimens with strongly raised costae. The microspheric and megalospheric forms are also very different in size and shape, but the whole series seems to belong to one distinct but variable species.

Genus *PALMULA* Lea, 1833

*PALMULA* cf. *BUDENSIS* (Hantken) (Pl. 6, fig. 3)

The only specimens from the Naheola material that can be referred to this species are immature, one of which is here figured. Mrs. Plummer records the species from the upper part of the Texas Midway. It also occurs in the upper part of the Midway near Livingston, Ala. As previously noted, this is probably not the same as Hantken's species, as shown by a study of topotypes, but not enough specimens are available to warrant complete description.

Genus *FRONDICULARIA* Defrance, 1826

*FRONDICULARIA NAHEOLENSIS* Cushman and Todd, n. sp. (Pl. 6, figs. 5, 6)

Test elongate, compressed, the periphery truncate, flattened or slightly concave, the sides angled, sometimes almost keeled, the sides nearly parallel for most of their length, initial end with a short stout spine, apertural end tapering to a blunt point; chambers few, strongly overlapping at the sides; sutures distinct, somewhat limbate, little if at all raised, strongly oblique; wall ornamented with numerous very fine longitudinal costae, independent of the sutures, the proloculum in the megalospheric form with a strong, central costa; aperture terminal, radiate. Length of holotype 0.87 mm. including spine; breadth 0.25 mm.; thickness 0.13 mm.

Holotype (Cushman Coll. No. 38289) from Naheola formation of Midway age, greensand bed, upper fossiliferous horizon, Naheola Landing, Tombigbee River, Ala.

This species differs from *Fronidicularia frankei* Cushman in the much smaller size, nearly parallel sides, and the sutures not raised.

Genus *LAGENA* Walker and Jacob, 1798*LAGENA* cf. *LAEVIS* (Montagu) (Pl. 6, fig. 4)

A few specimens with smooth surface, rounded base and distinct, elongate neck may be referred to this species. It is similar to the figure given by Toulmin from the Salt Mountain limestone of Alabama where it is recorded as common. Montagu's species is based on the figure given by Walker and Boys, and that is only remotely like our form. The species needs more material and further study.

## Family POLYMORPHINIDAE

Genus *GUTTULINA* d'Orbigny, 1839*GUTTULINA* cf. *PROBLEMA* d'Orbigny (Pl. 6, figs. 7-10)

Numerous specimens in the Naheola material are close to *Guttulina problema*. The early stages shown in our figures may possibly be the young of some other species of which no adults were found. Similar forms were found in the Midway of Alabama and Soldado Rock, off Trinidad. Toulmin records it as very common in the Salt Mountain limestone of Alabama (Journ. Pal., vol. 15, 1941, p. 594, pl. 80, fig. 8).

*GUTTULINA HANTKENI* Cushman and Ozawa (Pl. 6, figs. 11, 12)

*Polymorphina acuta* HANTKEN (not d'ORBIGNY), Mitth. Jahrb. K. Ungar. geol. Anstalt, vol. 4, 1875 (1881), p. 60, pl. 8, fig. 4 (*acuminata* on explanation of plate).

*Guttulina hantkeni* CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 33, pl. 5, figs. 4-6.—CUSHMAN and DUSENEURY, Contr. Cushman Lab. Foram. Res., vol. 10, 1934, p. 60, pl. 8, fig. 5.

The types of this species are from the Eocene of Hungary, but it is also recorded from the middle Eocene, Claiborne, of New Jersey, Louisiana, and California. The Naheola specimens are very similar to those from New Jersey.

Genus *GLOBULINA* d'Orbigny, 1839*GLOBULINA GIBBA* d'Orbigny (Pl. 6, figs. 13, 14)

(For references, see CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 60.)

There are numerous specimens of this common species in the Naheola material. It is recorded by Mrs. Plummer as common in the lower part of the Midway of Texas and rare in the upper part (Univ. Texas Bull. 2644, 1927, p. 122, pl. 6, fig. 8); from the



lower bed of the Midway near Livingston, Ala. (Cushman, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 63, pl. 11, fig. 6); and from the Midway of Soldado Rock, off Trinidad (Cushman and Renz, l. c., vol. 18, 1942, p. 7, pl. 2, fig. 4).

**Genus SIGMOMORPHINA Cushman and Ozawa, 1928**

**SIGMOMORPHINA WILCOXENSIS** Cushman and Ponton (Pl. 6, fig. 15)

*Sigmomorphina wilcoxensis* CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 61, pl. 8, fig. 7.

This species was described from Eocene material of Wilcox age from a R. R. cut, 1 mile N. of Ozark, Ala. Young specimens from the Naheola material seem to be the young of this Wilcox species. Specimens from the Salt Mountain limestone of Alabama are referred questionably to this species by Toulmin (Journ. Pal., vol. 15, 1941, p. 595, pl. 80, fig. 15).

**SIGMOMORPHINA cf. SEMITECTA** (Reuss), var. **TERQUEMIANA** (Fornasini)  
(Pl. 6, figs. 16, 17)

This variety has been recorded from the Eocene, and our specimens resemble the figures, especially those of the Eocene. Specimens are rare in the Naheola material.

**Genus RAMULINA Rupert Jones, 1875**

**RAMULINA cf. ACULEATA** (d'Orbigny) (Pl. 6, fig. 24)

Fragmentary specimens in the Naheola material are similar to ones recorded from the Midway material near Livingston, Ala. (Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 64, pl. 11, figs. 13, 14).

**Family HETEROHELICIDAE**

**Genus EOUVIGERINA Cushman, 1926**

**EOUVIGERINA EXCAVATA** Cushman (Pl. 6, figs. 20, 21)

*Eouvigerina excavata* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 66, pl. 11, fig. 18.

The types of this species are from the upper bed of the Midway, U. S. Highway 80, S. of Sucarnoochee Creek, 1/2 mile S. W. of Livingston, Sumter Co., Ala. This is the only recorded occurrence for this species. Typical specimens occur in the Naheola, but are rather rare.

Our specimens measure as follows: length 0.20 mm.; breadth 0.12 to 0.15 mm.

Genus *PSEUDOUVIGERINA* Cushman, 1927*PSEUDOUVIGERINA NAHEOLENSIS* Cushman and Todd, n. sp. (Pl. 6, figs. 18, 19)

Test small, broadly fusiform in front view, in end view triangular with the sides flattened or somewhat concave, the periphery angled and slightly carinate, or slightly truncate; chambers distinct, very slightly inflated in the last whorl; sutures distinct, slightly depressed in the later portion; wall distinctly perforate, generally smooth; aperture circular, at the end of a short but distinct cylindrical neck with a slight phialine lip. Length 0.30 mm.; breadth 0.15 mm.

Holotype (Cushman Coll. No. 38291) from Naheola formation of Midway age, greensand bed, upper fossiliferous horizon, Naheola Landing, Tombigbee River, Ala.

This species differs from *Pseudouvigerina wilcoxensis* Cushman and Ponton in the shorter, broader form and more fusiform test lacking the definitely grooved peripheral angles. It is perhaps more like *P. plummerae* Cushman from the Upper Cretaceous, but has a more definite neck and lip, and seems midway between this and *P. wilcoxensis*.

## Family BULIMINIDAE

Genus *ROBERTINA* d'Orbigny, 1846*ROBERTINA WILCOXENSIS* Cushman and Ponton (Pl. 6, figs. 22, 23)

*Robertina wilcoxensis* CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 66, pl. 8, fig. 19.—CUSHMAN and PARKER, l. c., vol. 12, 1936, p. 96, pl. 16, fig. 13.—CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 82, pl. 14, fig. 16.

This species was described from Eocene material of Wilcox age from R. R. cut 1 mile N. of Ozark, Ala., and later recorded from material of Wilcox age from Woods Bluff, Ala. From a comparison with the types, our specimens seem identical with the Wilcox species. It is of interest therefore to record this species from a still older formation. This is the first record of the genus from the Midway, and carries the range of the genus from Midway to Recent.



## Genus BULIMINA d'Orbigny, 1826

## BULIMINA CACUMENATA Cushman and Parker

*Bulimina cacumenata* CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 12, 1936, p. 40, pl. 7, fig. 3.—CUSHMAN, l. c., vol. 16, 1940, p. 67, pl. 11, fig. 20.

This species is very common in the material from Naheola Landing, and is typical. The types are from the Midway, 3 miles above bridge over Cedar Creek, on Austin-Red Rock road, Bastrop Co., Tex. It occurs also in the lower bed of the Midway, as exposed  $1\frac{1}{2}$  mile S. W. of Livingston, Sumter Co., Ala.

Specimens from the Naheola locality measure: length 0.20 to 0.25 mm.; diameter 0.10 mm.

## Genus ENTOSOLENIA Ehrenberg, 1848

## ENTOSOLENIA CRUMENATA Cushman (Pl. 6, fig. 28)

*Entosolenia crumenata* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 31, pl. 4, fig. 9.—CUSHMAN and McGLAMERY, U. S. Geol. Survey Prof. Paper 189-D, 1938, p. 109, pl. 26, fig. 11.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 66, pl. 11, figs. 4, 5.—CUSHMAN and McGLAMERY, U. S. Geol. Survey Prof. Paper 197-B, 1942, p. 70, pl. 5, figs. 16-18.

This species was described from the lower Oligocene of Mississippi, and is recorded from the Oligocene of Alabama. It also occurred in core samples from the ocean bottom off the east coast of the United States in material of Eocene age. In the Naheola material the species is rare.

## ENTOSOLENIA cf. LAEVIGATA (Reuss) (Pl. 6, fig. 27)

In the Naheola material, very rare specimens with a distinct keel may belong to this species.

## Genus BOLIVINA d'Orbigny, 1839

## BOLIVINA sp. (Pl. 6, fig. 25)

An incomplete specimen with very oblique sutures, smooth surface, and peculiar early chambers that seem almost as though partially subdivided, is figured. It cannot be assigned to any known species.

## BOLIVINA sp. (Pl. 6, fig. 26)

The figured specimen is a thick one with rounded periphery, nearly horizontal sutures, and the early portion with a rough surface. Without more material it is impossible to specifically identify it.

## Family ROTALIIDAE

## Genus SPIRILLINA Ehrenberg, 1843

SPIRILLINA cf. VIVIPARA Ehrenberg (Pl. 7, fig. 1)

A small species with the coils of even diameter and alike on both sides occurred in our material. The wall is unornamented but rather coarsely perforate. It is smaller, and the coils are much narrower than in the form noted from the Midway of Soldado Rock, off Trinidad, by Cushman and Renz (Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 10, pl. 2, figs. 14, 15). It resembles the figures of the form referred to "*Ammodiscus incertus* (d'Orbigny)" by Mrs. Plummer (Univ. Texas Bull. 2644, 1927, p. 63, pl. 13, figs. 1 *a-d*). Our specimen measures 0.17 mm. in diameter.

SPIRILLINA SELSEYENSIS Heron-Allen and Earland (Pl. 7, fig. 2)

*Spirillina selseyensis* HERON-ALLEN and EARLAND, Journ. Roy. Micr. Soc., 1909, p. 440, pl. 18, figs. 6, 7.—CUSHMAN and GARRETT, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 84, pl. 14, figs. 28, 29.

This highly ornamented species was described from the Eocene of Selsey Bill, Sussex, England. It occurs in the Eocene of Wilcox age at Woods Bluff, Ala. The single specimen figured was the only one obtained from the Naheola material, but has the characteristic ornamentation on both sides.

## Genus PATELLINOIDES Heron-Allen and Earland, 1932

PATELLINOIDES sp. (Pl. 7, fig. 3)

A single specimen here figured seems to belong to this genus, but not to any described species. The adult chambers make up about a half coil, and the sutures on the dorsal side are raised and plate-like. Toulmin figures a *Patellinoides* sp. from the Salt Mountain limestone of Alabama, but it is evidently not the same as that figured here.

## Genus DISCORBIS Lamarck, 1804

DISCORBIS (?) sp. (Pl. 7, fig. 4)

The single specimen figured is the only one found in the Naheola material of a small, deeply umbilicate species. The spire is fairly high, and there are about 4 chambers in the adult whorl. It is a small species and easily overlooked. Further material may show this to be a *Valvulineria*.



## Genus LAMARCKINA Berthelin, 1881

LAMARCKINA NAHEOLENSIS Cushman and Todd, n. sp. (Pl. 7, figs. 5-7)

Test small, longer than broad, dorsal side flattened or even slightly concave in the earlier portion, ventral side strongly convex, deeply umbilicate, periphery acute, even slightly keeled in the early stages; chambers distinct, about 8 in the adult whorl, increasing rapidly in size as added; sutures distinct on the dorsal side, slightly limbate as each chamber tends to slightly overlap the previous one, gently curved, on the ventral side indistinct; wall smooth, distinctly perforate on the dorsal side, smooth and polished on the ventral side; aperture opening into the umbilical cavity, with a large, slightly convex lip extending into and partially covering the umbilicus. Length of holotype 0.25 mm.; breadth 0.20 mm.; thickness 0.13 mm.

Holotype (Cushman Coll. No. 38293) from Naheola formation of Midway age, greensand bed, upper fossiliferous horizon, Naheola Landing, Tombigbee River, Ala.

This species differs from *L. wilcoxensis* Cushman in the narrower and smaller test, flattened dorsal side, large apertural lip, and limbate sutures. It is fairly common in the Naheola material.

LAMARCKINA LIMBATA Cushman and Todd, n. sp. (Pl. 7, figs. 8-10)

Test about as broad as long, biconvex, periphery acute and slightly carinate; chambers distinct, 5 or 6 in the adult whorl, increasing rapidly in size as added; sutures on the dorsal side strongly limbate and raised, only slightly curved toward the periphery, indistinct on the ventral side; wall distinctly perforate, slightly roughened on the dorsal side, especially on the earlier chambers, smooth and polished on the ventral side; aperture opening into the umbilical cavity, without a definite lip.

Length of holotype 0.32 mm.; breadth 0.28 mm.; thickness 0.18 mm.

Holotype (Cushman Coll. No. 38296) from Naheola formation of Midway age, greensand bed, upper fossiliferous horizon, Naheola Landing, Tombigbee River, Ala.

This species somewhat resembles *L. rugulosa* Plummer, but is less convex, has an acute rather than a rounded periphery, distinctly limbate sutures, and lacks the spinose surface.

## Genus GYROIDINA d'Orbigny, 1826

## GYROIDINA SUBANGULATA (Plummer) (Pl. 7, figs. 11, 12)

*Rotalia soldanii* (D'ORBIGNY), var. *subangulata* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 154, pl. 12, fig. 1.

*Gyroidina subangulata* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 71, pl. 12, fig. 7.—CUSHMAN and RENZ, l. c., vol. 18, 1942, p. 11, pl. 2, fig. 18.

The types of this species are from the Midway of Texas. It occurred in the upper bed of the material from near Livingston, Ala., and also in the Soldado Rock material from off Trinidad. It is fairly common in the collection from Naheola Landing.

## Genus EPONIDES Montfort, 1808

## EPONIDES LOTUS (Schwager) (Pl. 7, figs. 13, 14)

*Pulvinulina lotus* SCHWAGER, Palaeontographica, vol. 30, 1883, Pal. Theil, p. 132, pl. 28(5), fig. 9.

*Eponides lotus* CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 71, pl. 9, fig. 8.—GLAESSNER, Problems of Paleontology, Moscow Univ., vols. 2-3, 1937, p. 379, pl. 3, fig. 26.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 12, 1938, p. 7.—CUSHMAN and GARRETT, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 85, pl. 15, figs. 3-6.—ISRAELSKY, Proc. 6th Pac. Sci. Congress, 1939, p. 578, pl. 5, figs. 1-4; pl. 6, fig. 1.

This species was described from the middle Eocene of North Africa. Glaessner records it from the Tertiary of the Caucasus region, Bermudez from the Eocene of Cuba, and Israelsky from the Eocene of Marysville Buttes, Calif. It has been recorded from the Wilcox Eocene, 1 mile N. of Ozark, Ala., and from Woods Bluff, Ala. The specimens from the Naheola material are identical with those from the Wilcox and are common.

## Genus SIPHONINA Reuss, 1849

## SIPHONINA PRIMA Plummer (Pl. 7, figs. 16, 17)

*Siphonina prima* PLUMMER, Univ. Texas Bull. 2644, 1937, p. 148, pl. 12, fig. 4.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 72, Art. 20, 1927, p. 2, pl. 2, fig. 4; Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 71, pl. 12, fig. 10.

This widely distributed species is common in the Naheola material. It has already been recorded from the Midway of Texas and Alabama, and is widely distributed in the Coastal Plain area in the Cretaceous, upper part of the Navarro.



## Family AMPHISTEGINIDAE

## Genus ASTERIGERINA d'Orbigny, 1839

## ASTERIGERINA PRIMARIA Plummer (Pl. 7, fig. 18)

*Asterigerina primaria* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 157, pl. 12, fig. 8.

This peculiar species was described from the upper portion of the Midway of Texas where it was recorded as very rare. A single specimen, evidently identical, occurred in the Naheola collection. The structure of the test is unusual, and should be studied in detail when more specimens are available, as it does not seem typical of *Asterigerina*. An apparently related form is recorded by Toulmin from the Salt Mountain limestone of Alabama (Journ. Pal., vol. 15, 1941, p. 606, pl. 81, fig. 22).

## Family CASSIDULINIDAE

## Genus CERATOBULIMINA Toulou, 1920

## CERATOBULIMINA PERPLEXA (Plummer) (Pl. 7, figs. 23, 24)

*Rotalia perplexa* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 156, pl. 12, fig. 2.

*Ceratobulimina perplexa* CUSHMAN and HARRIS, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 173, pl. 29, fig. 2.—PLUMMER, (part) Amer. Midland Nat., vol. 17, 1936, p. 460, text figs. 1-4.—GLAESSNER, Studies in Micropaleontology, vol. 1, fasc. 3, 1937, pp. 20, 23, pl. 1, figs. 2, 3; pl. 2, fig. 25.

The types of this species are from the upper part of the Midway of Texas where it is recorded as very common. Its occurrence in typical form in the material from the Naheola locality indicates that it is a good species for an index fossil for this part of the Midway. Specimens are common and well preserved.

The species is recorded questionably from the Eocene of Marysville Buttes, Calif. by Israelsky (Proc. 6th Pac. Sci. Congress, 1939, p. 579, pl. 6, figs. 3, 4). It is also recorded by Puyt from the Eocene, Flysch, of Hercegovina, but the figures seem to show a different species (Geol. Pal. Besch. Umgebung von Ljubuski, Hercegovina, Utrecht, 1941, p. 69, pl. 1, figs. 58, 62).

## Genus PULVINULINELLA Cushman, 1926

PULVINULINELLA OBTUSA (Burrows and Holland) (Pl. 7, figs. 19, 20)

*Pulvinulina exigua* H. B. BRADY, var. *obtusa* BURROWS and HOLLAND, Proc. Geol. Assoc., vol. 15, 1897, p. 49, pl. 2, fig. 25.—PLUMMER, Univ. Texas Bull. 2644, 1927, p. 151, pl. 11, fig. 2.

*Pulvinulinella obtusa* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 11, pl. 2, fig. 16.

This species is common in the Naheola material, and has been recorded from the Midway of Texas and of Soldado Rock, off Trinidad. These seem to be identical with topotypes from the Eocene of Pegwell Bay, England.

Toulmin has recently created the genus *Alabamina* for a somewhat similar form from the Wilcox of Alabama (Journ. Pal., vol. 15, 1941, p. 602).

## Genus EPISTOMINOIDES Plummer, 1934

EPISTOMINOIDES MIDWAYENSIS Plummer (Pl. 7, figs. 21, 22)

*Epistominoides midwayensis* PLUMMER, Amer. Midland Nat., vol. 15, 1934, p. 605, pl. 24, fig. 4.

This species was described from the uppermost part of the Kincaid formation of the Midway Eocene, right bank of Colorado River, just below the Travis-Bastrop county line, in Bastrop Co., Tex.

It is common in the Naheola material. Specimens have the raised and limbate sutures and the same form with a distinct, narrow, terminal aperture with a thickened lip.

## Family CHILOSTOMELLIDAE

## Genus PULLENIA Parker and Jones, 1862

PULLENIA QUINQUELOBA (Reuss) (Pl. 7, fig. 15)

*Nonionina quinqueloba* REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 71, pl. 5, fig. 31.

*Pullenia quinqueloba* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 617, pl. 84, figs. 14, 15.—SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., 1889, p. 5, pl. 11, fig. 29.—BURROWS and HOLLAND, Proc. Geol. Assoc., vol. 15, 1897, p. 47, pl. 2, fig. 21.—COLE, Bull. Amer. Pal., vol. 14, No. 51, 1927, p. 32, pl. 5, fig. 15.—PLUMMER, Univ. Texas Bull. 2644, 1927, p. 136, pl. 8, fig. 12.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 73, pl. 12, fig. 17; vol. 16, 1940, p. 72, pl. 12, figs. 13, 14.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 607, pl. 81, fig. 24.



Except for the first two, the references are all from the Eocene where figures that seem identical with this form are given. The records give it a wide range from Cretaceous to Recent.

## Family GLOBIGERINIDAE

### Genus GLOBIGERINA d'Orbigny, 1826

#### GLOBIGERINA TRILOCULINOIDES Plummer (Pl. 8, figs. 1, 2)

*Globigerina triloculinoides* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 134, pl. 8, fig. 10.—JENNINGS, Bull. Amer. Pal., vol. 23, No. 78, 1936, p. 193, pl. 31, fig. 10.—GLAESSNER, Problems of Paleontology, Moscow Univ., vols. 2-3, 1937, p. 382, pl. 4, fig. 33.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 72, pl. 12, fig. 15.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 607, pl. 82, fig. 3.

This species was originally described from the Midway of Texas. Glaessner records it from the lower Tertiary of the Caucasus region. It occurs in the Midway near Livingston, Ala., and is in the Naheola material. Toulmin records it from the Wilcox, Salt Mountain limestone, of Alabama and from the Wilcox marl just above it, from the Bashi formation 20 miles south of Camden, Ala., rare in the Hatchetigbee formation of Alabama, and common in the Vincentown limesand of New Jersey. Jennings records it as rare in the Hornerstown formation of New Jersey. This would give a range from the basal Midway through the Wilcox and probably into the Claiborne.

#### GLOBIGERINA PSEUDO-BULLOIDES Plummer (Pl. 8, figs. 3, 4)

*Globigerina pseudo-bulloides* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 133, pl. 8, fig. 9.—NUTTALL, Journ. Pal., vol. 4, 1930, p. 290.—GLAESSNER, Problems of Paleontology, Moscow Univ., vols. 2-3, 1937, p. 382, pl. 4, fig. 31.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 72, pl. 12, fig. 16.

The types of this species are from the Midway of Texas. Nuttall records it from the lower Eocene, Aragon formation, of Mexico. Glaessner records it from the lower Tertiary of the Caucasus. It occurred in the Midway collections from near Livingston, Ala., and is present in typical form in the Naheola collections. It has not been recorded from the Wilcox Eocene.

## GLOBIGERINA COMPRESSA Plummer (Pl. 8, figs. 5, 6)

*Globigerina compressa* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 135, pl. 8, fig. 11.—JENNINGS, Bull. Amer. Pal., vol. 23, No. 78, 1936, p. 193, pl. 31, fig. 8.—GLAESSNER, Problems of Paleontology, Moscow Univ., vols. 2-3, 1937, p. 382, pl. 4, fig. 32.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 607, pl. 82, figs. 1, 2.

The types of this species are from the upper part of the Midway of Texas. It has also been recorded by Jennings from the Eocene, Hornerstown formation of New Jersey, by Glaessner from the early Tertiary of the Caucasus region and by Toulmin from the Salt Mountain limestone of the Wilcox Eocene of Alabama.

Specimens are rare in the Naheola collections, and indicate that possibly the species should be placed under *Globorotalia*.

## Family GLOBOROTALIIDAE

## Genus GLOBOROTALIA Cushman, 1927

GLOBOROTALIA CRASSATA (Cushman), var. AEQUA Cushman and Renz (Pl. 8, figs. 7-9)

*Globorotalia crassata* (CUSHMAN), var. *aequa* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 12, pl. 3, fig. 3.

Specimens apparently identical with this variety recently described from the Midway of Soldado Rock, off Trinidad, occur in the Naheola material.

## EXPLANATION OF PLATE 7

FIG. 1. *Spirillina* cf. *vivipara* Ehrenberg. × 130. 2. *S. selseyensis* Heron-Allen and Earland. × 140. a, dorsal view; b, ventral view. 3. *Patellinoides* sp. × 125. a, dorsal view; b, ventral view. 4. *Discorbis* (?) sp. × 150. a, dorsal view; b, ventral view. 5-7. *Lamarckina naheolensis* Cushman and Todd, n. sp. × 140. 5, Holotype. 6, 7, Paratypes. 5, dorsal view; 6, peripheral view; 7, ventral view. 8-10. *L. limbata* Cushman and Todd, n. sp. × 90. 8, Holotype. 9, 10, Paratypes. 8, dorsal view; 9, peripheral view; 10, ventral view. 11, 12. *Gyroidina subangulata* (Plummer). × 90. 11, ventral view; 12, dorsal view. 13, 14. *Eponides lotus* (Schwager). × 90. 13, dorsal view; 14, ventral view. 15. *Pullenia quinqueloba* (Reuss). × 90. 16, 17. *Siphonina prima* Plummer. × 90. 16, ventral view; 17, dorsal view. 18. *Asterigerina primaria* Plummer. × 140. a, dorsal view; b, ventral view. 19, 20. *Pulvinulinella obtusa* (Burrows and Holland). × 90. 19, ventral view; 20, dorsal view. 21, 22. *Epistominoides midwayensis* Plummer. × 75. 21, side view; 22, dorsal view. 23, 24. *Ceratobulimina perplexa* (Plummer). × 85. 23, dorsal view; 24, ventral view.







## GLOBOROTALIA cf. MEMBRANACEA (Ehrenberg) (Pl. 8, fig. 10)

The single specimen figured here has many of the characters of this species as developed in the Upper Cretaceous, Velasco shale, of Mexico. Our specimen has a roughened surface, however, instead of the normal smooth condition. Toulmin (Journ. Pal., vol. 15, 1941, p. 608, pl. 82, figs. 4, 5) records this species from the Salt Mountain limestone of Wilcox Eocene age from Alabama. There are other records from the lower Tertiary, but the figures are not typical.

## Family ANOMALINIDAE

## Genus ANOMALINA d'Orbigny, 1826

## ANOMALINA sp. (Pl. 8, figs. 11, 12)

A compressed species with a very coarsely perforate wall occurs in the Naheola material, but it is difficult to identify it with any of the species described from this part of the Eocene.

## Genus CIBICIDES Montfort, 1808

## CIBICIDES PRAECURSORIUS (Schwager) (Pl. 8, figs. 17-20)

*Discorbina praecursoria* SCHWAGER, Palaeontographica, vol. 30, 1883, Pal. Theil, p. 125, pl. 27(4), fig. 12; pl. 29(6), fig. 16.

*Cibicides praecursorius* CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 72, pl. 9, fig. 14.—CUSHMAN and GARRETT, l. c., vol. 15, 1939, p. 88.—TOULMIN, Journ. Pal., vol. 15, 1941, p. 610, pl. 82, figs. 19-21.—CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 13, pl. 3, fig. 9.

The types of this species are from the middle Eocene of northern Africa. It is common in the Wilcox Eocene of Ozark and Woods Bluff, Ala., and occurs in the Midway of Soldado Rock,

## EXPLANATION OF PLATE 8

FIGS. 1, 2. *Globigerina triloculinoidea* Plummer.  $\times 95$ . 1, ventral view; 2, dorsal view. 3, 4. *G. pseudo-bulloidea* Plummer.  $\times 90$ . 3, ventral view; 4, dorsal view. 5, 6. *G. compressa* Plummer.  $\times 140$ . 5, dorsal view; 6, ventral view. 7-9. *Globorotalia crassata* (Cushman), var. *aequa* Cushman and Renz.  $\times 90$ . 7, ventral view; 8, peripheral view; 9, dorsal view. 10. *G. cf. membranacea* (Ehrenberg).  $\times 140$ . a, dorsal view; b, ventral view. 11, 12. *Anomalina* sp.  $\times 90$ . 11, ventral view; 12, dorsal view. 13-15. *Cibicides blanchi* Toulmin.  $\times 95$ . 13, dorsal view; 14, peripheral view; 15, ventral view. 16. *C. newmana* (Plummer).  $\times 90$ . a, dorsal view; b, ventral view. 17-20. *C. praecursorius* (Schwager).  $\times 90$ . 17, 18, Young. 17, 20, dorsal views; 18, 19, ventral views.

off Trinidad. Toulmin records it from the Salt Mountain limestone and the marl above it, as well as from the Tuscahoma, Bashi, and Hatchetigbee formations of Alabama. Both adults and young specimens are figured from the Naheola.

**CIBICIDES NEWMANAE** (Plummer) (Pl. 8, fig. 16)

*Discorbis newmanae* PLUMMER, Univ. Texas Bull. 2644, 1927, p. 138, pl. 9, fig. 4.

This species was described from the lower part of the Midway of Texas. It has apparently not been referred to since in the literature. Very typical specimens occur in the Naheola material, and these seem to show that it should probably be referred to *Cibicides*.

**CIBICIDES BLANPIEDI** Toulmin (Pl. 8, figs. 13-15)

*Cibicides blarpiedi* TOULMIN, Journ. Pal., vol. 15, 1941, p. 609, pl. 82, figs. 11-13.

The types of this species are from the Wilcox Eocene, Salt Mountain limestone of Alabama and the marl overlying it. It is not surprising therefore to find the species in typical form in the Naheola material.



## RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand:

Rao, S. R. Narayana. *Lepidocyclina* from the Agate Conglomerates near Surat and Broach (Western India).—Current Science, vol. VIII, No. 4, April, 1939, pp. 167, 168, text figs. 1 *a-d*.

On the Occurrence of the Foraminiferal Genus *Orbitocyclina* in the Cretaceous Rocks of the Trichinopoly District, S. India.—L. c., vol. IX, No. 3, March, 1940, pp. 124, 125, text figs. 1-4.

On *Orbitosiphon*, a New Genus of Orbitoidal Foraminifera from the Ranikot Beds of the Punjab Salt Range (N. W. India).—L. c., vol. IX, No. 9, Sept., 1940, pp. 414, 415, text fig. 1.—A new genus *Orbitosiphon*, type *Lepidocyclina* (*Polylepidina*) *punjabensis* Davies.

On the Association of the Orbitoidal Genera *Discocyclina* and *Lepidocyclina* in the Yaw Stage (Priabonian) of Burma.—L. c., vol. IX, No. 9, Sept. 1940, pp. 415, 416, text figs. 1, 2.

The Tertiary Sequence near Surat and Broach (Western India), with Description of Foraminifera of the Genus *Pellatispira* from the Upper Eocene of This Region.—Journ. Mysore Univ., Sect. B. Science, vol. II, pt. II, 1941, pp. 5-17, pls. I, II.—Several species figured, the following new: *Pellatispira madaraszii* (Hantken), var. *indica*, var. nov., and *P. inflata* Umbgrove, var. *minor*, var. nov.

Cretaceous Orbitoids from the Upper Ariyalur Beds (Maestrichtian) of the Trichinopoly District, S. India.—L. c., vol. II, pt. IX, 1941, pp. 61-66, pl. VI.—The following species described and figured: *Orbitocyclina ariyalurensis*, sp. nov.; *Lepidorbitoides inornata*, sp. nov., and *L. blanfordi*, sp. nov.

Thalman, Hans E. *Hantkenina* in the Eocene of East Borneo.—Stanford Univ. Publ., Univ. Ser., Geol. Sci., vol. III, No. 1, 1942, pp. 1-24, text figs. 1, 2 (maps).—Includes a detailed discussion of the distribution of the species of the genus, and an outline of subgeneric characters.

Cushman, Joseph A. and Winnie McGlamery. Oligocene Foraminifera near Millry, Alabama.—U. S. Geological Survey Prof. Paper 197-B, 1942, pp. 65-84, pls. 4-7.—Seventy-one species and varieties are included, none new.

Chapman, Frederick. Report on Foraminiferal Soundings and Dredgings of the F. I. S. "Endeavour" along the Continental Shelf of the South-east Coast of Australia.—Trans. Roy. Soc. South Australia, vol. 65, pt. 2, 1941, pp. 145-211, pls. VII-IX.—Includes 203 species and varieties of foraminifera in addition to ostracoda and other groups. The following

foraminifera are new: *Planularia australis*, n. sp.; *Lagenonodosaria scalaris* (Batsch), var. *seminuda*, n. var.; *Bulimina notovata*, n. sp.; *Bolivinita quadrilatera* (Schwager), var. *tortilis*, n. var.; *Parafroidicularia helenae*, n. sp.; *Notorotalia decurrens*, n. sp.; *Chilostomella cushmani*, n. sp.; *Sigmoilina latissima*, n. sp.

**Palmer, Dorothy K.** Foraminifera of the Upper Oligocene Cojimar Formation of Cuba, Parts 4, 5.—Mem. Soc. Cubana Hist. Nat., vol. 15, (Part 4), No. 2, 1941, pp. 181-200, pls. 15-17; (Part 5), No. 3, 1941, pp. 281-306, pls. 28-31, 12 text figs.—The following are new: *Chrysalidinella* ? *cubensis*, n. sp.; *Uvigerina compressa*, n. sp.; *Siphogenerina yumuriana*, n. sp.; *Angulogerina cojimarensis*, n. sp.; *A. yumuriana*, n. sp.; *Epistomaria* ? *cubana*, n. sp.; *Siphonina cojimarensis*, n. sp.; *Baggina cojimarensis*, n. sp.; *Cassidulina pulmerae* Bermudez and Acosta, var. *intermedia*, n. var.; *Ehrenbergina bermudezi*, n. sp.; *Planorbulinella larvata* (Parker and Jones), var. *cojimarensis*, n. var.; *Uvigerina coartata*, n. name. *Siphogenerina yumuriana* is later placed as a synonym of *S. senni* Cushman and Renz.

**Cole, W. Storrs.** Stratigraphic and Paleontologic Studies of Wells in Florida. No. 2. Suwanee Petroleum Corporation's Sholtz No. 1. Florida Oil Discovery Company's Cedar Keys No. 2.—Florida Geol. Surv., Geol. Bull. No. 20, 1942, pp. 1-89, pls. 1-16, text figs. 1-3.—Describes and figures numerous Eocene and Upper Cretaceous Foraminifera, the following new: *Clavulina floridana*, n. sp.; *Cribrobulimina floridana*, n. sp.; *Lituonella elegans*, n. sp.; *Coskinolina elongata*, n. sp.; *Sigmomorphina floridana*, n. sp.; *Discorbis suturalis*, n. sp.; *D. inornatus*, n. sp.; *Gyroidina cretosa*, n. sp.; *Eponides gunteri*, n. sp.; *Asterigerina cedarkeysensis*, n. sp.; *Anomalina sholtzensis*, n. sp.; *Planulina cedarkeysensis*, n. sp.; *Linderina floridensis*, n. sp.; *Lepidorbitoides* (*Lepidorbinoides*) *floridensis*, n. sp.; *Lepidocyclina* (*Pliolepidina*) *cedarkeysensis*, n. sp.

**Moreman, W. L.** Paleontology of the Eagle Ford Group of North and Central Texas.—Journ. Pal., vol. 16, No. 2, Mar., 1942, pp. 192-220, pls. 31-34, 2 text figs.—Lists numerous foraminifera.

**Coryell, H. N. and R. W. Mossman.** Foraminifera from the Charco Azul Formation, Pliocene, of Panama.—L. c., pp. 233-246, pl. 36.—The following are new: *Robulus cushmani* Galloway and Wissler, var. *procedendus*, n. var.; *Pullenia malkinae*, n. sp.; *Valvulineria johnsoni*, n. sp.; *V. scintillans*, n. sp.; var. *sinecarina*, n. var.; *Gyroidina soldanii* d'Orbigny, var. *multilocula*, n. var.; *Cibicides terryi*, n. sp.; *Bolivina dottiana*, n. sp.; *B. pomposa*, n. sp.; *B. sinuata* Galloway and Wissler, var. *praevia*, n. var.; *Uvigerina gallowayi*, n. sp.; *U. buricensis*, n. sp.; *U. striata* Costa, var. *attenuata*, n. var.

**Dunn, Paul H.** Silurian Foraminifera of the Mississippi Basin.—Journ. Pal., vol. 16, No. 3, May, 1942, pp. 317-342, pls. 42-44.—Seventy-nine

arenaceous species are described and figured, 57 species and 2 varieties new. Four new genera are erected: *Thekammina* (genotype: *T. quadrangularis*, n. sp.); *Shidelerella* (genotype: *S. bicuspidata*, n. sp.); *Croneisella* (genotype: *C. typa*, n. sp.); *Gastroammima* (genotype: *G. williamsae*, n. sp.).

**Myers, Earl H.** Biological Evidence as to the Rate at Which Tests of Foraminifera Are Contributed to Marine Sediments.—L. c., pp. 397, 398, 1 text fig.—Data based on *Elphidium crispum* is given.

J. A. C.





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